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DOCUMENTARY EVIDENCE ON WEATHER CONDITIONS AND A POSSIBLE CRISIS IN 1315-1317: CASE STUDY FROM THE CARPATHIAN BASIN

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Abstract

In the last decades, climate variabilites of the fourteenth century gained great interest and became a subject of numerous research papers. Due to the relative lack of sources referring to the climate of the Carpathian Basin, merely based on written evidences continuous climate reconstruction of the period is not possible. Nevertheless, there are cases when, due to available contemporary evidence, still some conclusions can be drawn. In this paper an investigation is carried out on one specific environmental crisis characterized by several flood events of European rivers caused by repeated abundant rainfalls; moreover, summer and winter temperatures were lower than the average of the preceding century. As a result of unfavorable environmental and economic conditions, a great number of Western and Central European sources reported on famines caused by the destruction of cereals. Mainly based on Austrian and Czech narratives as well as Hungarian charters, in the present paper an attempt was made to collect all the available sources on prevailing weather conditions and their possible effects in the Hungarian Kingdom mainly referring to the period of 1315-1317.

Key words: climate variability, environmental crisis, weather events, floods, documentary evidence

WEATHER CONDITIONS IN THE 14TH CENTURY

Climatic conditions of the Middle Ages is a subject of several research papers, either as long-term investigations (e.g. Brázdil R. – Kotyza O. 1995, Pfister C. et al. 1998, Glaser R. 2001, Shabalova M. V. – Van Engelen A. F. V. 2003) or in the form of case studies on extremes events (e.g. Kiss A. 2003, Rohr C. 2005). Being already a part of the Little Ice Age, the 14th century is still considered as a transitional period between the Medieval Warm Epoch and the Little Ice Age, and this period poses several questions concerning variabilities of climate. A number of investigations pointed out that during this century temperatures in Western and Central Europe started to decrease (e.g. Lamb H. H. 1988, Pfister C. et al. 1996, Pfister C. et al. 1998, Yan Z. et al. 1999). In the Alps, the Aletsch Glacier started to advance from the 1120s and reached its maxima at around 1350 (Holzhauser H. 1997) which can be related to the decrease of temperature in the Alps from the second half of the 12th century to the 14th century. Climatic changes in the Czech lands are more questionable, since it is not possible to provide clear evidence on such phenomena in the first decades of the century (Brázdil R. – Kotyza O. 1995).

In this period temperature decreased and also wet years became more frequent, especially in the Western European territories. In Central and Eastern Europe there is no definite evidence for precipitation increase. For example, climate research of the Czech lands did not show an increase of precipitation during the 14th century (Brázdil R. – Kotyza O. 1995). Nevertheless, water-level increase was detected in the mines of Goslar (in Germany) and Iglau (today Jihlava in Czech Republic) (Steensburg A. 1951). Investigations on the Great Eastern European Plain pointed out a drier period (Lamb H. H. 1982). However, the water level of the Caspian Sea was several meters higher than nowadays (Gumilëv L. N. 1968), which does not reinforce the theory of a drier period in Eastern Europe.

From the 13th century the number of climatic extremes increased in Western Europe and so did the number of sea floods in the Northwestern European region (Lamb H. H. 1995). On the other hand, Central European investigations do not provide evidence on an increasing number of climatic extremes in the first half of the 14th century (Brázdil R. – Kotyza O. 1995).

Therefore, the weather of Western Europe was cooler and wetter than in the previous centuries. Weather conditions of Europe started to change and it had an effect on the food supply of the European population. During the 14th century crop prices increased (Le Roy Ladurie E. 2004, Pustil'nik L. A. – Yom-Din G. 2004) and in the years of the famine (1315-1317) the price of cereals were extremely high (Lucas H. 1930).

CONSEQUENCES OF EXTREME WEATHER IN EUROPE BETWEEN 1315 AND 1317

The second decade of the 14th century gained special attention among climate scientists. The 1310s was the decade in which "years without summer" occurred (Pfister C. 1992). In the mid-1310s a serious famine took place all over Europe (Jordan W. C. 1996). In England, for example, unfavorable weather conditions started

from 1314 with precipitation increase and temperature decrease, whereas prices were so high that in 1315 the king had to fix the maximum price of ale and meat (Kershaw I. 1973). In France, continuous rains started in May 1315. Due to great abundance of rains, cereals could not come to maturity and food shortage caused serious famine. There was no vintage in 1315, and the price of wine was high in 1316 (Alexandre P. 1987). According to Emmanuel Le Roy Ladurie (2004), in 1316 three million people died partly because of the lack of food. Same weather conditions and problems occurred in the Netherlands: the years of 1315-1317 were wet and serious famine occurred in Ypres and Bruges (Le Roy Ladurie E. 2004, 2006).

In the Mediterranean, historical records also indicate floods mainly in Northern Italy, in the area of Parma and Modena (Alexandre P. 1987). Historical records of the Iberian Peninsula are not yet published, but a dendroclimatological research indicates warmer period in the first half of the 14th century than in the preceding decades (Büntgen U. at al. 2008).

Table 1 Floods of rivers in the surroundings of Hungary between 1315 and 1317

Year	*Month*	*Source*	*Place*	*Flood of River*
1315	September	Chron. de gest. prin. MGH SS rer. Germ. Vol. 19. 84.	-	rivers in Austria
1315	After 25 July	Chron. Aul. Reg. 365.	Czech Kingdom	Rivers in Bohemia and Moravia
1316	23, 24, 28 June	Cont. Canon. S. Rud. Salis. 822.	-	Triplex flood of the Danube
1316	28 June	Ann. Burgh. MGH SS Vol. 24. 62.	-	Danube
1316	-	Anon. Leob. Chron. 33-34.	Austria, Hungary	Danube and Mura rivers
1316	-	Anon. Leob. Chron. 33.	Werfen, Austria	Salzach river
1316	-	Chron. Austr. 241.	-	Danube
1316	-	Ann. Mellic. Cont. Zwetl. Ter. 659.	-	Danube and its tributaries
1316	-	Mart. Meist. Ann. Gorl. 8.		Neisse river
1316	-	Chron. Aul. Reg. 379.	Czech Kingdom, Austria	Floods
1317	-	Ann. Zwetl. 681.	-	Danube and its tributaries
1317	-	Ann. Mellic. Cont. Zwetl. Ter. 666.	Czech Kingdom, Austria, Hungary	Danube

Records are as well available related to the German territories: annals and other narrative sources inform about flood events and extreme weather conditions from Bavaria to Estonia (Glaser R. 2001, Alexandre P. 1987). Besides the historical records dendroclimatologic data from the valley of the Rhine also supports the theory of the consecutive wet years (Le Roy Ladurie E. 2003).

EVIDENCE REFERRING TO SURROUNDING AREAS

Historical records from Austria and the other neighboring territories of the Carpathian Basin are very important in the light of the fact that narrative sources and annals from the Hungarian Kingdom are rare in the Middle Ages. In Austria, investigations were carried out based on historical records (Pautsch E. 1953, Rohr C. 2005, 2007), which provide further evidence to a possible comparison. It is interesting to note that according to some investigations based on O_{18} content of stalagmite records, summer temperatures in this period (Mangini A. et al. 2005) were not lower than in the preceding centuries. Nevertheless, according to Pfister (1996) winter temperatures were in the decade of the famine 1.7°C lower in the region of the Alpes than nowadays. Moreover, a number of annals and chronicles mention floods on the rivers of Austria in 1315, 1316 and 1317 (Table 1). From the Czech lands data are available on dry weather conditions before 25 July 1315; however, after this time chroniclers reported on great floods and famine (Chron. Aul. Reg. 365.) which continued in 1316. The same chronicle mentions bad harvest in 1317.

In the western neighborhood of Hungary, in Austria and the Czech lands these three years were rich in flood events. Record on famine is as well available referring to Austria, the Czech Kingdom and as well to Poland (Ann. Cist. in Hein. 546.). Fluctuation of crop prices in the 1310s also reflects unfavorable weather conditions (Table 2).

As a conclusion we can say that, similarly to Western Europe, in the neighbouring countries west and north to Hungary, presumably connected to weather conditions, floods and famine occurred, negatively affecting local population occurred in 1315-1317.

Table 2 Corn prices in the 1310s in the countries surrounding Hungary

Date	*Place*	*Barley (hordeum)*	*Wheat (triticum)*	*Wheat (siligineus)*	*Oat (avena)*	*Conditions*	*Source*
1312	Zwetl	70 denarius	½ talentum	3 solidus and 15 denarius	60 denarius	On the 26th of March.	Cont. Zwetl. Ter.
1312	Morvavia	--	30 grossi of Prague	--	--	After bad harvest	Chron. Aul. Reg.
1312	Zwetl	--	10 talentum	--	--	Around Easter	Ann. Zwetl.
1312	Mattsee	--	--	3 solidus	60 denarius	Serious famine	Ann. Mat.
1312	Austria	60 denarius	4 solidus	3 solidus	60 denarius	Famine	Chron. Austr.
1313	Zwetl	--	6 denarius	4 denarius	--	Good harvest	Ann. Zwetl.
1313	Zwetl	4 denarius	6 denarius	4 denarius	4 denarius	Good harvest, cheapness	Cont. Zwetl. Ter.
1313	Salzburg	--	3 solidus and 2 denarius	--	--	At Easter	Cont. Can. S. Rud. Salis.
1317	Salzburg	--	--	5 denarius	--	Famine	Cont. Can. S. Rud. Salis.
1317	Burghausen	--	--	--	--	Great famine	Ann. Burgh.
1319	Prague	--	--	1 grossi of Prague	--	Low prices after good harvest,	Chron. Aul. Reg.

INFORMATION ON CLIMATE OF HUNGARY IN THE EARLY 14TH CENTURY

Referring either historical or present Hungary, due to relative scarcity of available contemporary written evidence, research on climatic conditions as well have to rely ont he results of natural scientific research and archaeological investigations. Some studies in the field of archaeological research suggest that a drier period prevailed in the 13th century. However, it is very probable that the climatic conditions of Hungary started to change in the beginning of the 14th century and the climate became wetter in these decades (Rácz L. 2006).

It is, however, a general problem of natural scientific and archaeological research that in most cases changes can be detected, but it is difficult to differentiate the main reasons: it is uncertain whether mainly human impact or a possible climate change is more responsible for the changes. This question arises, for example, in current results of sand-dune research or waterlevel-change investigations of larger lakes of the Carpathian Basin. Sand-dune studies, for example, referring to the Danube-Tisza Interfluve indicate sand-movement in the first half of the 14th century (Kiss T. et al. 2005). Investigations on the main water-level tendencies of Lake Balaton pointed out that the water level had an increasing trend during the 14th century (Sági K. 1968, Kiss A. 1999b). Geoarchaeological investigations show a cooling period in the 14th century (Sümegi P. et al. 2005). A 1000-year dendroclimatological reconstruction is as well available on summer temperatures, referring to the Eastern Carpathians (Romania), which show cool years around 1300; however, this research points out hot summers in the 1310s (Popa I. – Kern Z. 2008). Nevertheless, due to the location of sample site, this reconstruction might not completely refer to the conditions of the Carpathian Basin in general, and the influence of more easterly areas should be as well considered. Thus, based on the presently available information, only a rather mosiac picture can be drawn. It is, however, appear rather clearly that a general change in environmental conditions can be detected in the early 14th century Hungary.

Concerning contemporary documentary evidence of Hungary, some investigations were already carried out referring to weather conditions of the 1310s in Hungary (Kiss A. 1999a). Moreover, a case study on the comparison of conditions between western Europe and Hungary in the mid-1310s suggested that, unlike west and north to us, no traces of a major crisis in 1315-1317 occurred in the Hungarian kingdom (Szántó R. 2005). Nevertheless, according to our opinion a deeper comparison of contemporary evidence of the neighbouring areas, as well as some additional, newly investigated domestic evidence can provide a not only slightly different, but clearly more detailed picture of what happened in the Carpathian Basin in the years of 1315-1317.

WEATHER-RELATED DOCUMENTARY EVIDENCE IN HUNGARY: 1315-1317

Largest number of contemporary evidence can be investigated first in the summary (regesta) collection of the Angevin Chartulary (An. Okl. Vol. I–XIV.), in which all presently available charter evidence of the reference period in Hungary are listed. Thus, the basis of our investigation was not only the years of 1315-1317, but a wider time-scale, namely the period of 1301-1330. it is due to the fact that, as we will see, clear evidence referring to the investigated period is available in charters issued after 1317. Apart from Hungarian charters, annals and chronicles of neighbouring countries were also examined (Table III and Fig 1). Despite the fact that only a low number of weather-related data is available concerning the first decades of the 14th century, some of the evidence provide interesting information. For example, one charter evidence (DL 63093) dated to 1309, referring to the village of Lehatha (today Horná Mičiná in Slovakia), reports on frequent previous flood events of the Garam (today Hron in Slovakia) river, which might show some connections to the increase of flood frequency in the period around 1300 occurred in Western Europe.

A charter from 1343 (DL 71639), transcribes another document from 1312 that is important for highlighting the food supply in the 1310s. The charter is seemingly a simple document which puts an issue in the sale of an estate on paper. The estate which is sold in this charter is called Pethunye (Petenia, Romania), but what has to be emphasized here is that the reason for selling one sixth of this estate complex was supposed shortages in the near future. The charter was issued on 25 June, 1312, exactly the period of the usual date of the grain harvest, which indicates that the harvest was very poor. It does not mean that the harvest was poor over a broader region as the charter does not specify the reason for the supposed shortage or food supply in the coming year, but it is possible that it was due to weather conditions.

A chronicle on the history of Szepesség (today Spiš-region in Slovakia) compiled in the 17th century by Caspar Hain (Hain G. 1910-1913), partly based on the local archival evidence, indicates a famine during three years around 1312 and mentions that cannibalism might have been present among the population. According to, for example, Lucas (1930) this phenomenon was not unique in time of famines but in this case it could as well be the vivid imagination of a 17th century author. In spite of probable exaggerations and the fact that it is not a contemporary source, this chronicle can have a great importance from our point of view. The author of this chronicle was the mayor of Lőcse/Leutscha (today Levoča in Slovakia) and thus, had an easy access to the town archives. Some of his reference suggest that he was familiar with, by now lost, medieval narratives, and thus, his descriptions about medieval period should be as well have to be considered (Hain G. 1910-1913). Thus, it is quite probable that Caspar Hain had access to reports referring to the early 14th-century famine. Thus, it is quite probable that some time in the early or mid-1310s a famine took place in Hungary. Although Hain dates this event to three years around and after 1312, but he also adds that the exact date is not sure (Hain G. 1910-1913).

Table 3 Weather related events in Hungary 1315-1317

No.	*Year*	*Day, Month*	*Source*	*Place*	*Event*
1	1309	-	DL 63903.	Lehotka (Slovakia)	Frequent floods of river Garam
2	1312	25 June (date of issue)	DL 71639	Petenia (Romania)	Presumed food shortage in the future
3	1312	-	Hain G. 13	Szepesség (Slovakia)	Serious famine in Hungary, cannibalism
4	1316	-	Anon. Leob. Chron. 33-34	Hungary	Serious floods
5	1316	-	Chron. Aul. Reg. 379	Hungary	Serious floods caused by continuous rains, unusual weather
6	1317	24 February (date of issue)	DL 1884.	Sava valley (Croatia)	Hard conditions because of winter
7	1317	-	Ann. Mellic. 511.	Hungary	Floods of rivers
8	1318	-	DL 50333	Keserű (Romania)	Serious famine in the past

Concerning 1315, no direct evidence is available related to weather events of the Hungarian Kingdom. Thus, it is yet uncertain whether or not abundant precipitation and floods, occurred from England through France to Austria, reached the Carpathian Basin. However, contrary to 1315, some source evidence is available about the next year, 1316. The *Anonymus Leobiensis Chronicon* informs about serious floods destroying villages along the

Danube in Austria and Hungary. The *Chronicon Aulae Regiae* (Bohemia) reports on succeeding unusual weather events, and floods caused by continuous rains. Thus, in this year not only the precipitation was greater than usual, but the number of weather extremes as well increased in the areas west to us.

Serious flood of River Mura was reported in 1316, which probably as well reached Hungary (Anon. Leob. Chron. 33-34). In the same period, King Charles Robert passed the Drava river (takes the water of river Mura) with his army and we do not have any source reporting on difficulties. Based on this we cannot state that this flood undoubtedly reached and caused problems in Hungary.

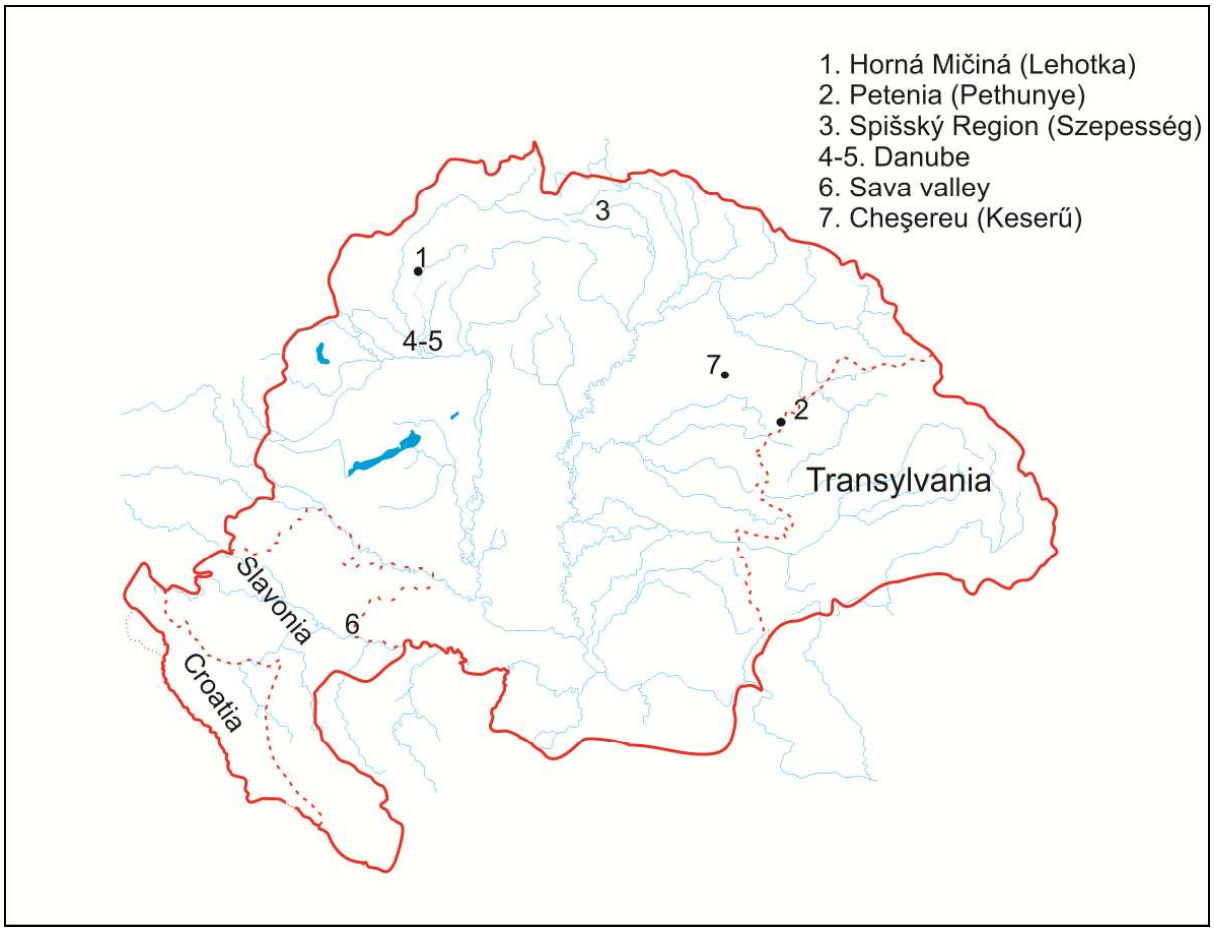

Fig. 1 Geographic names in medieval Hungary, referred in the article

A charter written in 1323 (DL 1884) transcripts the text of another charter dating back to 24 February 1317 provide evidence on the great difficulties of the royal army when, caused by hard winter conditions, they crossed the Sava river. As no more details are available, no clear statement can be provided on the actual weather conditions disturbing the army from crossing the Sava river. Nevertheless, the winter of 1317 was, according to the *Chronicon Aulae Regiae*, extremely long and cold (lasted until 28 March) in the Czech lands. Thus, there is a high probability that the winter of 1317 was also colder than usual in Hungary. However, a deeply frozen Sava river in itself would have allowed an easier pass to the king's army.

The last data to be discussed here is a, dated to 1318 (DL 50333). The charter mentions a certain Stephen who gave proof of his charity when he helped his family during a time of serious famine. This is the only unquestionable contemporary written evidence from the Carpathian Basin which refers to famine in the preceding period. It does not specify when the famine took place, but the charter is a continuation of another document dating back to 1311, which means the famine mentioned in the charter took place some time between 1311 and 1318. The charter from 1318 was issued by the monastery of

Várad (Oradea, Romania) concerning an estate called Keserű (Cheşereu, Romania). Seemingly, there was a famine in that region, which does not mean that it touched the whole country. However, the fact that the scribe did not specify which famine the charter refers to may indicate that it was a well known event and affected a broader geographical area.

Even if only a few written evidence is available related to a famine and possible environmental crisis of the mid-1310s (see *Fig 1*), these sources provide clear evidence that the crisis, mainly in the form of high prices and famine indeed reached Hungary.

CONCLUSION

Great parts of Europe were clearly affected by the weather anomaly of the mid-1310s. As a result, great famine occurred in western and central Europe. Crisis clearly affected territories in the immediate neghbourhood: unfavourable weather conditions and famine occurred in Austria, the Czech lands and Poland. Whereas some case studies suggested that no contemporary information can support the idea that crisis also reached Hungary in 1315-1317, it seems that some contemporary charters indeed suggest that signs of the same crisis and famine were present and caused problems in different parts of contemporary Hungary.

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ABBREVIATIONS OF PRIMARY SOURCES

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